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ABSTRACT

The study involving 112 deaf undergraduate students at the National Technical Institute for the Deaf (NTID) was designed to review recent educational and psychological literature relating to learning strategy knowledge and use, to determine which cognitive strategies might be most effective for learners, and to pilot a questionnaire for assessing strategy use among deaf students. Through the review of educational and psychological literature, four areas (imagery, questioning, paraphrasing, and understanding concept relationships) were identified as areas in which training students processing strategies may benefit comprehension and retention. By developing sets of items, administering them to NTID students, and facotr analyzing responses, nine scales were identified that measure student's strategies for processing instructional material. The nine Learning Strategy Questionnaire scales are: Study Flexibility, Imagery, Application, Creative Elaboration, Relationships, Understanding, Sign Language and Reinforcement, Ease of Studying, and Selection/Retention. Tables with statistical data are appended. (Author/SB)

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THE DEVELOPMENT OF A COGNITIVE PROCESS BASED LEARNING STRATEGIES QUESTIONNAIRE

Paper Series No. 23

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April, 1978

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ABSTRACT

The purposes of this study were: 1) to review recent educational and psychological literature relating to learning strategy knowledge and use; 2) to determine which cognitive strategies might be most effective for learners; and 3) to pilot a questionnaire for assessing strategy use among deaf students. Through the review of the recent educational and psychological literature, four areas (imagery, questioning, paraphrasing, and understanding concept relationships) were identified as areas in which training students processing strategies may benefit comprehension and retention. By developing sets of items, administering them to NTID students and factor analyzing responses, nine scales were identified that measure student's strategies for processing instructional material. The nine Learning Strategy Questionnaire scales are: Study Flexibility, Imagery, Application, Creative Elaboration, Relationships, Understanding, Sign Language and Reinforcement, Ease of Studying and Selection/Retention.

INTRODUCTION

One of the major problem areas in deaf education has been the difficulty deaf students have in learning from written (prose) materials. In 1974 the average 19 year old student in schools and programs for the deaf in the United States had a reading comprehension level of 4th grade, 4th month, comparable with that of a ten year old hearing student (Trybus and Karchmer, 1977). Reading and understanding prose materials is the backbone of self-education. Comprehending text material in school and in magazines, newspapers and job-related matters following graduation is crucial to individual self development. An inability to learn from prose materials severely limits the deaf student and puts him/her at a disadvantage in comparison to other persons who can read, understand and remember prose materials.

What are the options for improving deaf students' understanding of prose materials? The first option is to manipulate the materials, changing them in ways that help the student understand. Examples of material manipulation are lowering the vocabulary level, simplifying the syntax and decreasing the information load (density) of the material. These all seem like viable options on first examination and they may facilitate the comprehension process. However, material manipulation is not a practical option when we consider the number of different types of material (texts, magazines, newspapers, etc.) that would need revision to facilitate the deaf student's comprehension.

The second option is to train and encourage students to use strategies for disecting and comprehending prose materials. There is an ancient proverb that conveys the advantages of the second option, "give

a man a fish and he eats for a day; teach a man to fish, and he eats for a lifetime." Our long term goal is to improve the learning skills of deaf students. The specific purposes of this study were: (1) to review recent educational and psychological literature relating to learning strategy knowledge and use; (2) to determine which cognitive strategies might be most effective for learners; and (3) to pilot a questionnaire for assessing strategy use among deaf students. In addition, the questionnaire developed in this study was used to examine whether strategies differ as a function of such variables as: a) reading vocabulary level, b) communication skills, c) academic achievement, and d) major area of study. Information for the development of the Learning Strategies Questionnaire (LSQ) came from previous attempts at developing strategy questionnaires and from literature on prose learning and imagery.

Prose Learning and Imagery

From an extensive review of the educational and psychological literature (Dansereau, Actkinson, Long and McDonald, 1974) it is readily apparent that much educational research and development efforts have been directed toward the improvement of teaching, rather than learning strategies. Many studies have dealt with manipulations of academic-like material rather than examining or manipulating the processes students use when studying. However, some of the results from studies on inserted questions, advance organizers and imagery, may have valuable applications for designing a questionnaire to measure the use of student strategies.

The numerous investigations dealing with the insertion of questions in prose materials originated from the works of Hershberger (1964), Rothkopf (1966) and Frase, Patrick and Schumer (1970). The results of these studies indicated that experimenter-generated questions seem to

facilitate comprehension and retention of academic materials. That is, questions which appear before the material to which they relate (pre-questions) seem to have a substantial facilitative effect, but the effect does not generalize to material not covered in the questions. Inserted questions which appear after the material to which they relate (post questions) have a substantial specific facilitative effect as well as a small general facilitative effect on post test scores. Thus, questioning during study seems to be a valuable aid to the study process. For this reason, students in the present study were asked how often they asked themselves questions during a lecture and while studying. They also indicated how frequently they asked teachers questions during and after class and how frequently they asked and answered questions of other students.

According to Ausubel (1963) an "advance organizer" is an outline of the novel ideas in a set of material presented at a high level of generality and abstraction. Ausubel and Youssef (1963) and Barnan and Glass (1969) conducted several studies to determine what effect these general summaries would have on the acquisition of unfamiliar materials. Broad summaries were presented prior to and after segments of study material. The results of these studies indicated that when prose materials are particularly difficult or novel, or when the subject's ability is limited with respect to the passage being learned, organizers that are general and abstract can facilitate retention of the materials. Ausubel's findings on the facilitative effects of general summaries provided the basis for including questions on paraphrasing in the Learning Strategies Questionnaire. More specifically, students were asked how often they try to put material into their <u>own words</u> when taking notes in class, studying for a test, answering test questions or explaining information to other students.

Paivio (1971) and Dansereau, Long, McDonald and Actkinson (1975) reported that the formation of visual images can greatly enhance the retention of material, especially highly imaginable material. Paivio argued that imagery is effective in the retention of material because it establishes an additional encoding beyond the verbal input provided by the prose material. Imagery may also be effective because many segments of material can be captured in one image. Thus, imagery may be an effective way of chunking large segments of material. In the present study, students were asked how often they created "a picture in your mind", during class, when reviewing notes, or trying to remember material for a test.

The development of the Learning Strategies Questionnaire was not limited to the findings of the studies reported above. Other studies on note taking (Carter and Van Matre, 1975, Di Vesta and Gray, 1972, Osguthorpe and Long, 1978) relationships between concepts (Collins and Quillian, 1969, Long, 1976) and mnemonic techniques (Bower, 1973) were reviewed in a similar manner in an effort to abstract potentially effective learning strategies. Previous attempts at developing strategy questionnaires were also an important source of information during the development of the L.S.Q.

Prior Approaches to the Development of Learning Strategy Questionnaires

Responses to self-report inventories may be distorted by attempts to provide socially desirable responses, inappropriate interpretations of the items, lack of self-awareness, etc. However, if care is taken in developing questionnaire items and interpreting the subsequent results, the problems involved in identifying strategies in this way are overshadowed by the economy and efficiency associated with this approach.

Five major inventories dealing with individual differences in learning style have appeared in the professional literature. These include: (1) the Survey of Study Habits and Attitudes (SSHA) developed and revised by Brown and Holtzman (1953, 1966); (2) the Study Behavior Questionnaire (S.B.Q.) developed by Biggs (1970); (3) the Study Strategy Questionnaire (S.S.Q.) developed by Goldman and Warren (1973); (4) The Learning Strategy Inventory developed by Dansereau, Long, McDonald and Actkinson (1975); and (5) the Inventory of Learning Processes (ILP) developed by Schmeck, Ribich and Romanaiah (1977).

Generally, these inventories are composed of a potpourri of items. Some deal with academic skills and techniques such as promptness in dealing with assignments, ability to deal with distractions, academic savvy, planfulness, clerical diligency and note taking. Others include items which deal with academic attitudes and beliefs such as attitudes toward teaching methods and teachers, tolerance of ambiguity, dogmatism, and capacity for intrinsic motivation. What these inventories have in common is their attempt to assess individual differences in learning style. After reviewing the literature in this area, Tallmadge and Shearer (1969, 1971) concluded that learning style assessed from a <u>behavioral process</u> orientation is likely to be more useful than one based purely on a personality or cognitive style orientation. Of the previous strategy questionnaires, the ILP developed by Schmeck et al. (1977) most closely follows the suggestions of Shearer by using behaviorally oriented items to assess learning processes. The major difficulty with the ILP is that the authors used a fairly weak criteria for inclusion of items in a scale (i.e., items with factor loadings

above /.25/). Thus, the analyses resulted in only four scales, each of which had nine heterogeneous collections of items, making interpretation of specific processes assessed by each scale difficult.

Taking the constraints of the previous instruments into consideration, the results of these studies are abstracted as follows:

-Inventory responses have had negligible correlations with ability measures such as the Scholastic Aptitude Test.

-Inventory responses have been significantly related to traditional measures of word recall and recognition in a traditional verbal learning paradigm.

-Inventory responses have had significant correlations with a measure of comprehension in a "typical" classroom learning situation.

-Differences in responses to inventory items have been related to students' major area of study.

The results of the work with these inventories have led some investigators to conclude that strategies associated with specific tasks may be more fundamental determinants of academic success than are abilities per se, and that educators and researchers should seek the "most efficient" learning strategies for given academic tasks.

The major shortcoming of these previously published inventories lies in their construction. Generally they have been based on intuitive notions of important academic behaviors. They have either not taken into account the cognition/information processing literature or they have constructed items in a fashion that inhibits their being used for diagnosis. That is, most inventories are not developed in a fashion that allows for a coherent interpretation of the process being measured

by a specific scale. Also, none of the previously developed inventories were targeted at the specific strategies of deaf learners. The Learning Strategy Questionnaire was developed in an effort to remedy some of the shortcomings of previous inventories by using behaviorally oriented items focused on specific strategies.

Structure of the Learning Strategy Questionnaire

The Learning Strategy Questionnaire is composed of 117 items. Some of these items were derived from previous questionnaires for purposes of comparison with prior results. Some are autobiographical in nature. Still others are directed at possible learning strategies used by deaf students. Many of the LSQ items were derived from empirical results appearing in the psychological and educational literature. In this latter category, the items attempt to describe a typical academic task and the student indicates how frequently he/she uses a cognitive process (such as imagery) in dealing with such a task.

The following is a list of the a priori subscales in the LSQ. Many of the items had some overlap with each other; however, an attempt was made to direct items toward each of the following categories:

autobiographical
academic self-reliance
memory processes
imagery processes
general reading skills
rehearsal in sign language
reorganization of study material
question asking and answering
paraphrasing
relationships between concepts
use and distribution of time
rote rehearsal
application of information
concentration
test-taking skills

identification of important concepts
cognitive styles
general study skills
test-taking skills
note-taking and classroom behavior
media preference
attention
goal-setting

These categories are presented merely to give the reader a flavor of the questionnaire, along with an overview of the possible a priori areas for item construction. Subsequent factor analyses and scaling analyses led to more formal specifications.

Instrument Development

The objective of this phase of the study was to identify clusters of items which could be used to develop internally consistent scales. The initial item pool was divided into two subsets of items in an effort to maintain an adequate items-to-students ratio. The first subset was constructed to contain items that measured "primary strategies" (procedures used to manipulate or reorganize material). The second subset, "secondary strategies," focused on support strategies such as concentration and test-taking skills. Responses to the two subsets of items were subjected to a truncated principal components factor analysis (Gorsuch, 1974). Scales and scoring keys were then constructed using items with factor loadings $\geq$ /.30/.

Subjects. The initial sample consisted of 112 deaf undergraduate students at the National Technical Institute for the Deaf (NTID) in Rochester, New York. Students who failed to answer five or more questions were excluded from the analyses. The final sample (n=97) was composed of 55 males and 42 females, with an average age of 21.12 years and a mean stay at NTID of 4.27 quarters.

Procedure. The original form of the questionnaire consisted of 117 multiple choice items that focused on learning behaviors in which students might engage to varying degrees. The students were instructed to respond to the items (on standard IBM answer sheets) and to indicate which methods they actually used, and not what they thought or knew were the "best" methods.

Of the original 117 items in the questionnaire, ten were autobiographical in nature and five items were not answered by at least one-third of the respondents. These fifteen items were not included in subsequent analyses. The remaining 102 items were divided into primary (52 items) and secondary (50 items) subsets. Each group of items subsequently was subjected to a separate factor analysis.

Factor analyses of the learning strategies questionnaire followed the procedures outlined by Gorsuch (1974). A truncated principal components factor analysis was performed on each of the subsets of items. Only factors with eigenvalues $\geq$ 1.00 were retained for further analyses. These procedures resulted in ten factors for the primary strategies items and ten factors for the secondary strategies items. The principal components solutions then were subjected to a varimax rotation procedure (Gorsuch, 1974) and orthogonal factors were extracted.

In order to determine the internal consistency of the scales which resulted from the factor analyses, the saliently loading items ($\geq$ /.30/) from each factor were entered into an item analysis. Coefficient alphas were calculated for each scale.

Results and Discussion

The principal components factor analysis of the intercorrelations among the 52 primary strategy items and the 50 secondary strategy items resulted in ten factors with eigenvalues $\geq$1.00 for each subset of items. Table 1 presents the results of this analysis, giving the items which comprise each factor and their loadings on that factor.

Insert Table 1 about here

Also included in Table 1 are the alpha coefficients for each factor. Coefficient alpha is a measure of the internal consistency of a scale and, therefore, represents an estimate of the expected correlation of a scale with an alternative form of the scale containing the same number of items. Since internal consistency is an important criterion for evaluating the psychometric status of an instrument, only scales with alpha $\geq$.60 will be considered further in this paper.

Five of the primary strategy factors had coefficient alpha's $\geq$ .60. Factor I consisted of items which stress the extent to which one changes his/her study procedures (depending upon the course, type of exam, and exam performance) and was named STUDY FLEXIBILITY. Factor II consists of items which relate to the use of images or pictures in one's mind as a study aid and guide to recall of information at test time. Factor II was labeled IMAGERY. Factor III measures the extent to which students try to apply classroom information to: a job setting, one's interests,

TABLE 1

Description of Primary and Secondary Factors in Terms of Their Salient Items

Factor Name	Item	Answer Type[a]	Factor Loading	Coefficient Alpha
	Primary Strategies			
I.	Study Flexibility			80
	How much do you change your method of studying when you have done poorly on an exam?	A	80	
	How much do you change your study habits from course to course?	A	73	
	How much do you change your study habits according to the type of test you will take?	A	70	
	How much do you change the way you organize your study material when you have done poorly on an exam?	A	69	
II.	Imagery			81
	When taking a test, how often do you use images or pictures to help yourself recall information?	F	78	
	In class, how often do you try to form a picture in your mind of the material the teacher is talking about?	F	76	
	When you review your notes, how often do you use images or pictures to help you remember the material?	F	75	
	How often do you find yourself forming a picture (in your mind) of the material you are studying?	F	55	

TABLE 1 (continued)

Description of Primary and Secondary Factors in Terms of Their Salient Items

Factor Name	Item	Answer Type[a]	Factor Loading	Coefficient Alpha
	Primary Strategies			
III. Application				67
	When studying for a test, how often do you try to think of ways you could apply or use that information on the job?	F	76	
	When reviewing material for a test, how often do you try to think of examples that are related to a job you might have in the future?	F	75	
	How often do you explain (in your own words) material that you have read to other students?	F	45	
	You are reading a course assignment and find that the material relates to something that you are interested in. How often does this happen?	F	44	
	While attending a lecture, how often do you try to think of ways you can apply the information the instructor is presenting?	F	30	
IV. Creative Elaboration				66
	When taking a test, I try to put my answers in my own words.	C	72	
	I use the examples I think up when I study to aid my recall of the material during a test.	C	67	
	I like to build on my own understanding of material that I learned before, with the new information presented in class.	C	53	
	When taking notes in class, I try to put the material into my own words.	C	46	

TABLE 1 (continued)

Description of Primary and Secondary Factors in Terms of Their Salient Items

Factor Name	Item	Answer Type[a]	Factor Loading	Coefficient Alpha
	Primary Strategies			
V.	General Study			52
	When I am studying for a test, I reorganize the material so that similar ideas, definitions, results, etc., are grouped together.	C	56	
	When studying a textbook, how often do you stop and try to remember the material without looking back?	F	51	
	How often do you ask your teacher questions outside of class?	F	44	
	While studying, I try to reorganize the material so that I better understand how the terms are related to each other.	C	39	
	When studying an assignment for a course, how often do you go to other books that you are familiar with and look up that topic?	F	34	
	When studying a textbook, how often do you ask yourself questions about the material?	F	32	
VI.	Relationships			69
	When attending lectures, how often do you try and relate the material being presented to material you already know?	F	71	
	While reading, how often do you stop and try to relate what you just read to material that was presented earlier in the text?	F	67	
	When reading textbooks, how often do you try to relate the material you are studying to material you already know?	F	57	
	How often do you find that information learned in one class helps with the material of other classes?	F	48	
	When studying for an exam, how often do you make up your own study material by bringing together information from your notes and textbook?	F	35	

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TABLE 1 (continued)

Description of Primary and Secondary Factors in Terms of Their Salient Items

Factor Name	Item	Answer Type[a]	Factor Loading	Coefficient Alpha
	Primary Strategies			
VII. Reorganization and Review of Notes				53
	How often do you review your own notes?	F	76	
	How often do you reorganize your own notes?	F	49	
	How much do you reorganize material when you are studying?	A	31	
VIII. Order of Learning				34
	When taking an exam, I often find that I have learned the material in one order and the exam requires a different order.	C	50	
	How often do you read quickly through an entire paragraph to get the general idea of what the entire paragraph is about, before reading it to get the details?	F	47	
IX. Note Type				46
	How do you take notes?		70	
	a. I try to copy as much of what the instructor is saying as I can. b. I write notes in outline form (for example, headings, sub-headings, details) c. I only try to write down the major points. d. I very rarely take notes at all.			
	How often do you take your own notes?	F	45	
	When taking notes from a textbook, how much do you rewrite the material into your own words (rather than using the author's words)?	A	44	

TABLE 1 (continued)

Description of Primary and Secondary Factors in Terms of Their Salient Items

Factor Name	Item	Answer Type[a]	Factor Loading	Coefficient Alpha
	Primary Strategies			
X.	Planning			56
	In writing a term paper, how often do you make a "rough draft" before producing the final product?	F	64	
	How often do you make out a weekly study schedule?	F	54	
	How often do you make an outline before you start writing a term paper?	F	35	
	Secondary Strategies			
I.	Understanding			78
	How often do you have trouble understanding just what a test question is asking?	F	73	
	How often do you find yourself memorizing rules, definitions, formulas, etc., <u>without</u> understanding them?	F	62	
	How often do you sit through a lecture and feel like you don't understand what the teacher is saying?	F	57	
	How often do you find yourself memorizing class notes <u>without</u> really understanding them?	F	49	
	In taking tests, writing themes, etc., I often find that I have misunderstood what is wanted and lose points because of it.	C	45	
	How often do you get nervous and uptight when you are studying?	F	44	

TABLE 1 (continued)

Description of Primary and Secondary Factors in Terms of Their Salient Items

Factor Name	Item	Answer Type[a]	Factor Loading	Coefficient Alpha
	Secondary Strategies			
II.	Sign Language and Reinforcement			66
	How often do you practice materials you are trying to remember in sign language?	F	83	
	While taking a test, how often do you use sign language to help you remember material?	F	70	
	Sometimes it is hard to keep studying. How often do you say to yourself, "I'll study for a while, then I will treat myself to a coke, break," etc.?	F	42	
III.	Test Taking Skills			54
	When taking a test, how often do you use information from one test question to help you answer another?	F	71	
	If you have trouble remembering an answer for a test, how often do you make an effort to recall things that are related to it?	F	61	
	I study where there are many distractions (T.V., friends, etc.).	C	36	
	In taking a test, how often do you go through and answer the questions you are sure of first and then go back to questions you are less sure of?	F	33	

TABLE 1 (continued)

Description of Primary and Secondary Factors in Terms of Their Salient Items

Factor Name	Item	Answer Type[a]	Factor Loading	Coefficient Alpha
	Secondary Strategies			
IV. Coping with Exams				52
	When studying for an exam I am usually: a. very nervous b. a little nervous c. relaxed d. very relaxed		83	
	When taking an exam, I am usually: a. very nervous b. a little nervous c. relaxed d. very relaxed		74	
	Before you take an exam, how much time do you spend trying to remember the study material without reading it again?	A	65	
	If you had a choice, which of the following types of exams would you prefer taking? a. multiple choice b. fill in the blanks c. essay d. oral		62	

TABLE 1 (continued)

Description of Primary and Secondary Factors in Terms of Their Salient Items

Factor Name	Item	Answer Type[a]	Factor Loading	Coefficient Alpha
	Secondary Strategies			
V.	Ease of Studying			67
	My reading assignments are hard to understand.	C	62	
	I can remember material that I have signed better than material that I have read or seen others sign.	C	62	
	I find that I have a hard time getting started studying.	C	41	
	When reading a textbook, how difficult is it for you to pick out the important material?	D	32	
VI.	Material Preference			56
	Imagine that you are taking a political science course. The following are examples of types of material you may be asked to learn. Which type of material would you most enjoy studying?		82	
	a. the names of all the Supreme Court Judges and when they served			
	b. the definitions of legal terms			
	c. the relationship between Supreme Court rulings and the present American legal system			
	d. theories about the influence of Supreme Court Judges			

TABLE 1 (continued)

Description of Primary and Secondary Factors in Terms of Their Salient Items

Factor Name	Item	Answer Type[a]	Factor Loading	Coefficient Alpha
	Secondary Strategies			
	Which type of material would you prefer to be tested on?		66	
	a. the names of all the Supreme Court Judges and when they served b. the definitions of legal terms c. the relationship between Supreme Court rulings and the present American legal system d. theories about the influence of Supreme Court Judges			
	What kind of material do you prefer to be tested on?		38	
	a. specific facts b. words and their definitions c. how words are related to each other d. theories			
VII. Selection and Retention				66
	How often do you come to a test question that you are sure you know the answer, but you just can't quite think of it?	F	71	
	When you take a test, how often do you feel like you know the material but you are just not able to remember it at test time?	F	55	
	When taking a test, how often do you find that you didn't study the material that the teacher thought was important?	F	41	
	You have read some material for a course, and you feel that you understood what was said. A classmate then asks you a question on the material or you try to remember some of the material yourself and you find that you can't remember much of what you have read. How often does this happen to you?	F	39	

TABLE 1 (continued)

Description of Primary and Secondary Factors in Terms of Their Salient Items

Factor Name	Item	Answer Type	Factor Loading	Coefficient Alpha
	Secondary Strategies			
	It is easy for me to pick out the important items (nouns, phrases, definitions, etc.) from a sentence or paragraph.	C	32	
VIII. Use of Visual Aids				46
	I prefer a test with no illustrations (for example, pictures, graphs, etc.)	C	65	
	The instructor is much easier to understand when he/she uses an overhead projector or blackboard illustrations.	C	49	
	I usually like to concentrate on the tables, graphs and pictures in a reading assignment.	C	33	
IX. Reading Flexibility				45
	I often skip over things in my reading that I already know.	C	73	
	As I read, I decide how difficult the material is and change my reading speed accordingly.	D	42	
X. Reading Flexibility				38
	I usually read different kinds of reading materials (for example an article in a newspaper versus a chapter in a textbook) at different speeds.	C	69	

TABLE 1 (continued)

Description of Primary and Secondary Factors in Terms of Their Salient Items

Factor Name	Item	Answer Type[a]	Factor Loading	Coefficient Alpha
	Secondary Strategies			
	When I go from a difficult part to an easy part, my reading speed automatically increases.	C	32	
	I usually check over my exam paper for errors before turning it in.	C	32	

Note: All decimal points have been omitted.

[a]The following letters correspond to the answer types in Table 1:

F - Frequency (a. never, b. rarely, c. sometimes, d. often, e. almost always)
A - Amount (a. not at all, b. sometimes, c. a small amount, d. a moderate amount, e. quite a bit)
D - Degree of Difficulty (a. very difficult, b. somewhat difficult, c. not very difficult, d. fairly easy)
C - Concurrence (a. strongly agree, b. agree, c. not sure, d. disagree, e. strongly disagree)

or discussions with other students. Factor III was named APPLICATION. Factor IV was designated CREATIVE ELABORATION because it examines the extent to which students paraphrase (put material in their own words) and generate examples while studying. Factor VI examines the extent to which students integrate information by relating new information to old, from one context to another. Factor VI was named RELATIONSHIPS since it examines the extent to which students examine the relationships between different concepts or segments of material. Factors V, VII, VIII, IX and X will not be discussed since their coefficent alpha's did not meet the criterion.

Four of the secondary strategy factors had coefficient alpha's above .60. Factor I consists of items that ask how frequently the student has difficulty understanding test questions, rules, definitions, formulas, class notes and the teacher, and was called UNDERSTANDING. Factor II asks about the use of sign language as a rehearsal and retrieval aid along with the scheduling of reinforcement for studying. Factor II was labeled SIGN LANGUAGE AND REINFORCEMENT. Factor V represents a mixture of items that relate to ease of understanding, identification of important concepts and recall of material. Factor V was designated the EASE OF STUDYING factor. Factor VII consists of a subset of items asking about the student's ability to pick out the "important" material in a text when studying, and a subset of items examining the ability to retrieve information from memory that was stored previously. Factor VII was named SELECTION AND RETENTION. Factors III, IV, VI and VIII, IX, and X did not meet the criterion for internal consistency and were not

used in subsequent analyses. In summary nine factors (five from the primary strategies and four from the secondary strategies) resulted from the factor analysis with internal consistency estimates sufficiently high to be used in subsequent analyses.

Table 2 presents scale intercorrelations between the nine remaining scales. It can be seen that the scales are relatively independent with the strongest relationship (r=.53) occurring between Understanding and Selection-Retention, indicating that these measures have 28% of their variance in common. The remaining phases of this study (Group Comparisons and LSQ - Performance Relationships) are concerned with the application of the nine LSQ scales.

Insert Table 2 about here

GROUP COMPARISONS

Three comparisons were made contrasting: (1) deaf students in different majors; (2) deaf students in different degree programs; and (3) deaf and hearing students. The impetus for this type of comparison originated from a study by Goldman and Warren (1973) who found that college students in different majors reported using different types of strategies. Goldman and Warren's most dramatic differences were found between art students and science students. Comparisons 1 and 2 above were made by using multiple discriminant analysis (MDA). The MDA procedure maximizes discrimination between groups by combining the scales in a manner which provides the greatest average separation between groups relative to the variability within a group. Multiple discriminant analysis derives a linear combination of the scales in a way that maximizes differences between groups of individuals. Then M.D.A. determines if the score profiles for the groups are statistically different.

TABLE 2

Intercorrelations of the Nine LSQ Scales

		1	2	3	4	5	6	7	8	9
1.	Study Flexibility	--								
2.	Imagery	26*	--							
3.	Application	14	-05	--						
4.	Creative Elaboration	19	11	14	--					
5.	Relationships	13	24*	34*	33*	--				
6.	Understanding	-19	-04	10	15	02	--			
7.	Sign Language and Reinforcement	27*	13	02	04	03	-25*	--		
8.	Ease of Studying	-33*	-03	-13	08	-13	29*	-42*	--	
9.	Selection and Retention	-34*	06	00	10	-20	53*	-03	23*	--

* p <.05

Note: Scale intercorrelations were based on a sample of 65 subjects. Decimal points have been omitted.

Subjects for M.D.A. A sample of 76 deaf students with complete data were selected from the original group of 112 students in order to make these comparisons. These students were all enrolled in classes at NTID. There were 6 Diploma, 44 Associate, and 26 Baccalaureate students. Four major areas of study were represented. Thus, there were 24 Business majors, 18 Engineering majors, 24 Science majors and 10 Visual Communication majors. The hearing students (n=41) were volunteers from an introductory psychology class at the Rochester Institute of Technology.

Results and Discussion. The first multiple discriminant analysis comparison was made using the 76 deaf students to determine if students from the four areas of study represented by this sample reported using different study strategies. The total between-group variance of the nine L.S.Q. scales had a chi-square value of 22.46 (df = 27). The MDA results were not significant, nor were the univariate analysis of variance comparisons for each scale. Thus, Business, Engineering, Science and Visual Communication students have comparable scale scores on the nine LSQ scales. The means for each major area on the nine LSQ scales are contained in Appendix A.

The second MDA comparison was conducted to determine if students in different degree programs reported using different study strategies. The MDA results were the same as those using major area of study. That is, the overall test of group differences was not significant with a chi-square of 17.72 (df = 18). However, the univariate comparisons for each of the nine scales indicated that the groups differed significantly

on the Creative Elaboration Scale ($F_{2,73} = 3.5$, $p < .01$). Upon examination of the group means presented in Appendix B, it is apparent that diploma students indicated that they used less creative elaboration (M= 13.00) than did students in the Associate (M= 15.77) or Baccalaureate (M= 15.85) programs. This finding needs to be interpreted with caution, since only six Diploma students were included in the present sample and the multivariate (MDA) test of differences was not significant.

The third and final group comparison contrasted deaf and hearing students on the nine scales included in the L.S.Q. Table 3 presents the means and standard deviations for deaf and hearing students on each scale. No statistical test of group differences was performed since the group means on each scale differ by less than one standard deviation.

Insert Table 3 about here

Thus, the deaf and hearing groups sampled in this study reported using the nine L.S.Q. strategies to about the same extent. It is difficult to generalize about deaf-hearing student similarities or differences since the deaf students studied in this investigation were a heterogeneous sample, whereas the hearing students all came from the same introductory psychology class. However, the data contained in Table 3 suggest that, on these nine learning strategy scales, deaf and hearing students behave similarly.

The striking finding of the group comparisons is the similarity of responding of the different groups. With one minor exception, it appears

Table 3. Means and standard deviations on the learning strategies questionnaire scales for deaf and hearing students.

L.S.Q. Scales	Deaf Students (n=76) M	SD	Hearing Students (n=41) M	SD
Study Flexibility	12.6	3.5	11.5	4.3
Imagery	13.5	3.2	13.6	3.3
Application	15.4	3.0	14.71	2.9
Creative Elaboration	15.6	2.6	14.54	2.4
Relationships	16.0	2.8	17.1	3.1
Understanding	19.6	4.4	20.6	3.1
Sign Language and Reinforcement*	7.4	2.4	---	---
Ease of Studying	11.2	2.5	9.9	2.4
Selection and Retention	15.8	2.8	15.9	2.6

*Means and standard deviations were not calculated for hearing students on the Sign Language and Reinforcement Scale since none of the hearing sample knew sign language.

that degree program, major area of study and whether the student is deaf or hearing has little impact on the use of various learning strategies measured by the L.S.Q. There was only one hint of a group difference. NTID students in the Diploma program reported using less creative elaboration than did the Associate or Baccalaureate program students. The following section examines the relationship between scores on the L.S.Q. scales and a number of aptitude and achievement measures.

LEARNING STRATEGY - PERFORMANCE RELATIONSHIPS

The objective of this phase of the study was to examine relationships between scores on the nine L.S.Q. scales and measures of student aptitude and achievement. The aptitude measures were the NTID Simultaneous Reception Test, and the Vocabulary and Comprehension Components of the California Reading Test (Junior High School Battery) which were administered to students prior to admission to NTID. The achievement measures were overall G.P.A. (four-point scale) and the total number of points earned on three tests during one quarter of introductory psychology at NTID. The subjects were a sample of the NTID students used in the previous phases of this study. The following is a brief explanation of each of the aptitude measures.

The Simultaneous Reception Test is a subtest of the CID Everyday Sentence List developed at NTID (Johnson, 1976). In this test, a person is presented with multiple cues (listening, speech reading, sign and/or fingerspelling) for receiving information. A student's score is the percent correct from 50 key words identified from 10 sentences.

The vocabulary test is a subtest of the California Reading Test (Junior High Level). This is a standardized instrument with 60 items assessing vocabulary in mathematics, science, social science and "general".

The comprehension test is a subtest of the California Reading Test (Junior High Level). This is a standardized instrument consisting of items related to following directions, reference skills, and interpretation of materials. For information on the validity of the vocabulary and comprehension measures the reader is referred to Walter (1974).

Correlations between the nine L.S.Q. scales and the aptitude and achievement measures are presented in Table 4. Upon examination of the aptitude - L.S.Q. correlations, it can be found that the Ease of Studying scale has significant positive correlations with all three aptitude measures. The Ease of Studying Scale is composed of items that ask how difficult it is to understand assignments, begin studying, and pick out the important material. Thus, the aptitude - scale correlations indicate that it is easier for students with good receptive skills and high vocabulary and comprehension scores to understand the assignment, get started studying and pick out the important material than it is for students with poor receptive skills and low vocabulary and comprehension ability. One other item in the Ease of Studying Scale asks how easy it is for a student to remember material he has signed himself rather than material he has simply read or seen others sign. There is some indication based on the positive aptitude - scale correlation that students with good receptive skills, high vocabulary and comprehension scores feel that they remember material better when they read it or see others sign it than if they sign it for themselves.

There are two other significant positive L.S.Q. - aptitude correlations in Table 4. Creative Elaboration has a significant positive correlation with Simultaneous Reception. This correlation indicates that students with good receptive skills tend to paraphrase information and use examples when studying more frequently than do students with poor receptive skills. The Relationships Scale has a positive correlation with Comprehension. This finding indicates that students who try to interrelate concepts when studying have better comprehension scores than do students who don't interrelate information. (See Table 1.)

Table 4.

Correlations Between L.S.Q. Scale Scores, Aptitude and Achievement Measures

L.S.Q. Scales	Aptitude Measures			Achievement Measures	
	Simultaneous Reception (n=65)	Vocabulary (n=65)	Comprehension (n=65)	G.P.A. (n=65)	Psychology Points (n=30)
Study Flexibility	12	02	13	-02	06
Imagery	11	15	09	15	-27
Application	-09	-23*	-29*	-26*	14
Creative Elaboration	21*	-05	11	-14	21
Relationships	03	15	23*	-12	23
Understanding	00	-07	-04	10	08
Sign Language and Reinforcement	-17	-25*	-26*	-06	-03
Ease of Studying	27*	38*	41*	03	20
Selection and Retention	-24*	-21*	-25*	03	-21

*$p < .05$

[a]Decimal points omitted.

[b]All scales were scored so that a high scale score indicates more (Study Flexibility, Imagery, etc.) than a low scale score.

Three L.S.Q. scales had negative correlations with the aptitude measures. These relations are in the direction opposite that anticipated by the authors and can be summarized in the following manner:

1. Application: Students with high vocabulary and comprehension scores tend to spend less time trying to apply classroom information than do low vocabulary students.
2. Sign Language and Reinforcement: Students with high vocabulary and comprehension skills tend to spend less time rehearsing and retrieving information in sign language than do low vocabulary and comprehension students. The high vocabulary and comprehension students are also less likely to schedule reinforcement breaks than are the poorer aptitude students.
3. Selection and Retention: Students with high receptive, vocabulary and comprehension scores tend to have more difficulty in selecting and remembering important information than do students with low aptitude scores.

Only one L.S.Q. scale had a significant correlation with grade point average (G.P.A.) or psychology points. The negative correlation of application and G.P.A. indicates that students with high G.P.A. tend to spend less time trying to apply classroom information than do low G.P.A. students.

CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

The purposes of this study were: (1) to review recent educational and psychological literature relating to learning strategy knowledge and use; (2) to determine which cognitive strategies might be most effective for learners; and (3) to pilot a questionnaire for assessing strategy use among deaf students. Although the majority of the present research and development efforts were directed toward the development of the Learning Strategies Questionnaire, much of the information presented in this report can be used as a guide for conceptualizing potential strategies for training students. Through the review of recent educational and psychological literature, four areas (imagery, question asking and answering, paraphrasing, and understanding concept relationships) were identified in which training students to employ processing strategies may benefit comprehension. By developing sets of items, administering them to NTID students and factor analyzing responses, nine scales were identified that measure various aspects of the learning process. These nine scales and their foci are:

Scale	Focus
Study Flexibility	Changing study procedures based on feedback
Imagery	Using internal pictures or images to remember information
Application	Relating new information to a future job or previous knowledge
Creative Elaboration	Paraphrasing (putting study material into one's own words) and using examples to aid recall
Relationships	Interrelating the material (concepts) in a text and relating new information to old

Understanding	Ease of understanding instructions, test questions, rules, definitions, class notes
Sign Language and Reinforcement	Practicing study material in sign language and setting up "study breaks"
Ease of Studying	Ease of getting started studying, reading the material and picking out the important ideas
Selection and Retention	Picking out the important information (nouns, phrases, definitions, etc.) and remembering that information at test time

Although some potentially effective strategies were identified, the present attempts to pilot the L.S.Q. and assess its validity yielded mixed findings. Comparison of student subgroups within the samples studied indicated that degree program, major area of study and whether the student studied was deaf or hearing had little impact on the reported use of the nine L.S.Q. strategies. Students in the Diploma program indicated less use of Creative Elaboration (putting study material in their own words) than did students in the Associate or Baccalaureate programs. However, a large sample of students is needed to assess the generalizability of this finding.

Correlations between scale scores on the Creative Elaboration scale and scores on the aptitude measures indicated that paraphrasing study material was positively related to students' receptive skills, vocabulary and comprehension abilities. The Relationship scale and comprehension measures were positively correlated, indicating that students who tend to interrelate concepts in a text, and relate new information to old, get better comprehension scores than do students who do not

focus on relationships between concepts. Three of the L.S.Q. scales (Application, Sign Language and Reinforcement, and Selection-Retention) had one or more negative correlations with the aptitude measures. These negative L.S.Q. aptitude relationships were unexpected. The correlations indicate that students with high receptive, vocabulary, or comprehension scores tend to engage in Application, Sign Language and Reinforcement, and Selection-Retention less frequently than did students with low aptitude scores. The Application scale also had a negative correlation with G.P.A., which means that high G.P.A. students reported applying terms less frequently than did low G.P.A. students.

The goals of the present study were to identify some potentially effective strategies and to pilot a questionnaire measuring these strategies. A number of learning strategies were identified, but the present attempt to validate the L.S.Q. has had many limitations. The following is a list of some of these limitations:

I. L.S.Q. Limitations

   a) too few items per scale

   b) no measure of test-retest reliability

   c) reading level of some items may be too difficult for low vocabulary students

II. Sample and Other Limitations

   a) the same students were used for factor analysis, scaling analysis, group comparisons, and assessing L.S.Q.-aptitude and achievement relationships

   b) sample sizes for most analyses were small

   c) restrictive criteria (only 30 people had psychology points, G.P.A. had restricted variance [M=3.06, standard deviation=0.51]

Future studies using the L.S.Q. should increase the number of items per scale, administer the questionnaire to a larger sample of students, obtain reliability data and examine the scale's properties over time. Future studies also should employ multiple criterion measures (e.g., comprehension scores from small segments of material, and total points from different courses). A cross-validation design also is suggested in order to allow the weights derived from one sample to be used to predict performance in other samples of subjects.

APPENDIX 1

Means on the learning strategies questionnaire scales for NTID students in different majors and degree programs.

Table A. Means on the learning strategies questionnaire scales for students in four (4) different majors at NTID.

L.S.Q. SCALES	Business (N=24)	Engineering (N=18)	Science (N=24)	Visual Communications (N=10)
Study Flexibility	13.04	12.88	12.29	11.60
Imagery	13.04	13.67	14.04	13.90
Application	15.62	14.78	15.42	15.10
Creative Elaboration	15.58	15.44	15.92	15.10
Relationships	15.67	16.28	16.46	15.00
Understanding	18.29	19.05	19.79	22.10
Sign Language & Reinforcement	8.79	7.11	6.88	7.50
Ease of Studying	10.50	10.78	11.75	11.60
Selection and Retention	15.67	14.94	15.83	17.40

Table B. Means on the learning strategies questionnaire scales for students in three (3) degree programs at NTID.

L.S.Q. SCALES	Diploma (N=6)	Associate (N=44)	Baccalaureate (N=26)
Study Flexibility	11.50	12.45	13.00
Imagery	13.50	13.43	13.61
Application	15.17	15.91	14.50
Creative Elaboration	13.00	15.77	15.85
Relationships	14.83	15.93	16.31
Understanding	21.00	19.64	19.15
Sign Language & Reinforcement	7.17	7.77	6.81
Ease of Studying	11.83	11.04	11.31
Selection and Retention	16.67	15.86	15.35

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